LITTLE BLUE BOOK NO. 1139
Edited by E. Haldeman-Julius

Photography Self Taught

Lloyd I. Snodgrass

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PHOTOGRAPHY SELF TAUGHT

CHAPTER I

INTRODUCTION

Of all the fields of applied science, there is perhaps no other that has such a universal appeal as photography. While a science in the true sense of the word it enters so intimately and frequently into contact with our daily lives that we hardly realize its scientific aspect.

Photography is simply the making of permanent images of natural objects on suitably prepared surfaces by physical and chemical means. The process is easily understood and the actual making of good pictures is simplicity itself. The light reflected from the subject being photographed passes through the lens and forms an image on the sensitive material at the back of the camera. An exposure of only a small fraction of a second, if the light is good, affects this material but not to the extent of forming a visible image. The actual image is brought out later by a chemical process called "development." After being "fixed" so the image won't fade, the "negative," as the film or plate is now called, is washed and dried and is then ready for printing. This is done by allowing a given amount of light to pass through the negative onto a piece of sensitive paper with which it is placed in contact. After being developed, washed and dried, this paper is the finished print or picture.

Photography had its early beginning back in

the fore part of the 18th century[1] when the "Camera Obscura" was devised.

This was a box equipped with a lens at one end and a piece of ground glass at the other, used by artists to trace a picture on the glass. Some time later various experiments were made to find something to replace the ground glass which would permanently retain the image. Eventually it was discovered that silver chloride would darken upon exposure to light and that *hypo* would remove the unexposed chemical, thus fixing the image more or less permanently.

Later came the daguerreotype and the wet plate process. The latter was very cumbersome, but many beautiful pictures were made by it, as witnessed by Brady's collection of Civil War pictures. These were succeeded by dry plates which in turn have quite largely given way to films.

Photography as it exists today covers a very broad field, and many books have been written on the subject as a whole and its various phases. In compiling the material for this Little Blue Book, an attempt has been made to include only those topics which will be of interest and assistance to the average amateur photographer. Scientific processes are explained in such a way that the beginner, with no previous experience in the making of pictures, should be able to understand the various steps as they are taken up, and to get good pictures. The last chapter is devoted to the scope of photography, its practical applications, and to some of the developments that are now taking place.

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[1]See Photo-Miniature No. 60: ***Who Discovered Photography.***

CHAPTER II

MATERIALS OF PHOTOGRAPHY

He who builds a house, manufactures an automobile, works the farm, or produces a picture, must have certain materials and tools to work with. In the case of photography the tools consist of the camera and its accessories, the sensitive films or plates, chemicals and other supplies.

TYPES OF CAMERAS

Box Cameras, when reduced to their simplest form, consist of a light tight box with a lens at one end and a place for the sensitive film at the other. Such cameras are usually fitted with a fixed focus single (meniscus acromatic) lens, one or two ground glass view finders, and a simple type of shutter. Also, there may be a system of two or three "stops" for regulating the amount of light admitted by the lens.

A camera of this type is well suited for children and for the beginner. There is nothing much to get out of order, the camera is ready on the instant for whatever photographic subject may turn up, and the pictures obtained compare very favorably with those produced by the most expensive instruments. However, such cameras have their limitations. Snapshot exposures are only possible in good light when the sun is shining on the subject; objects nearer than about 10 feet cannot be photographed unless an auxiliary lens is used over the regu-

lar lens, and the camera is not so convenient for carrying as a folding type. The Brownie is one of the best known of box cameras.

Folding cameras, such as the Kodaks, are preferred by the great majority of workers. These range from the very small folding models of vest pocket size taking pictures 1⅝x2½ inches, through the 2¼x3¼, 2½x4½, 2⅞x4⅞, up to the 3¼x5½, which is one of the most popular sizes.

Cameras of this type ordinarily have rapid lenses and many are fitted with the highest type of anastigmat lenses. Brilliant view finders are usually furnished as the image is much more clearly seen than in a ground glass finder. They are ordinarily fitted with shutters which in addition to time and bulb action may work at automatic speeds from one second to perhaps 1/200. This makes it possible to get snapshots of subjects under conditions that would be out of the question with the box cameras with their slower lenses and shutters. Some of these cameras are provided with an autographic feature so that data can be made on the film at the time of the exposure. Some are fitted with combination backs so that accurate focusing may be done on the ground glass on the back. Most styles use roll film although some are fitted to take film packs and cut film.

Reflecting cameras fitted with focal plane shutter, are the type preferred by many advanced workers. A mirror reflects the image onto a ground glass, full size and right side up where it is focused and remains visible in a hood until the very instant of exposure, and thus it takes all the guesswork out of composition, lighting and focusing. Some focal

plane shutters work as slow as 1/5 second. Such an exposure is very useful for home portraits indoors where the light is good. Focal plane shutters also permit of extremely rapid exposures. Cameras of this type are used when photographing automobile races, athletic events, etc. Naturally a reflecting camera is somewhat larger and heavier than an ordinary folding camera.

There are also many scientific, commercial and special purpose cameras, among which might be mentioned stereoscopic, telephoto, photomicrographic, enlarging, copying and reducing, lantern slide, identification, finger print, cirkut, panoramic, studio, view and motion picture cameras.

Practically all amateur work today is made with small film cameras. In many of the amateur photographic exhibitions large pictures will be seen but in most cases the foundation of these pictures was a small film negative. In selecting a camera it is well worth while to consider the fact that any camera, even the cheapest will make fair pictures under favorable conditions. It is only when convenience in regard to compactness and ease of operation along with the ability to fully expose and make microscopically sharp pictures under unfavorable conditions are desired, that the more complicated and expensive models are of superior advantage.

LENSES[2]

In order properly to understand the purpose and use of the lens it is necessary to know something about the nature of light. Light or-

[2]For a more exhaustive discussion, see Harting: *Optics for Photographers.*

dinarily travels in a straight line but when a beam falls on a polished surface such as a looking glass it is reflected back in the same way that a rubber ball striking the ground rebounds. It is this *reflected light* from objects, that reaching our eyes enables us to see them, and reaching the lens of the camera enables us to photograph them.

As in the case of sound where low pitched notes are caused by a small number of vibrations per second and high pitched ones by a great number so in the case of light the red is produced by long wave lengths and violet by short ones. Between these are all the other colors from red to violet—orange, yellow, green, blue. There are wave lengths shorter than violet called ultra-violet, which are not visible but are very active in affecting a photographic emulsion. White light is made up by all colors.

Refraction is another property of light which very directly concerns our discussion of lenses. When a stick is placed in water at an angle, it appears to be bent at the surface. The explanation of this is that in a dense medium, light travels slower than in air. When the beams strike the surface one part reaches the surface and is slowed up while the other part is still in the air and traveling faster, thus causing a change in direction. The same thing taking place in glass explains the action of light in passing through the lens.

PINHOLE LENS. The simplest lens which we could use would be a small hole. If we take a sheet of cardboard and make a hole in it with a pin and then in a darkened room, hold the cardboard between a sheet of white paper and an electric lamp we shall see on the paper an image of the lamp's filament. The same

principle is applied to the making of pinhole photographs A very fine smooth hole is made in a piece of thin brass or tin-foil and this is used in place of the lens. The diagram (Figure 1) shows how the image is formed by the use of the pinhole.

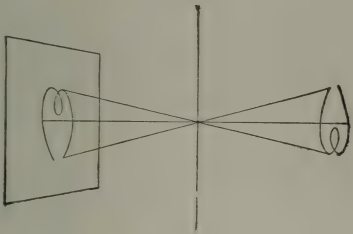


Fig. 1

Remarkably good pictures can be made with nothing but a pinhole for a lens. No object is perfectly sharp but all are equally sharp and the result may be very fine pictorially. However, the exposure is very long, taking from a few seconds up to several minutes with the object in good bright sunlight even when a very fast film is being used. As the pinhole is made larger so as to admit more light, then the image will become more and more indistinct until no picture is formed at all.

Formation of an Image by a Lens. When a ray of light passes through a prism it is bent as it enters the glass and again as it leaves it. The lens works very much the same as two prisms.

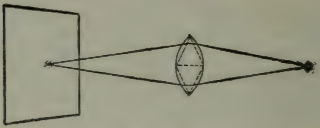


Fig. 2

The lens is used in the front of the camera for the purpose of so directing the rays of light that they will form an image of the object being photographed on the sensitive film or plate in the back of the camera. Figure 3 shows how

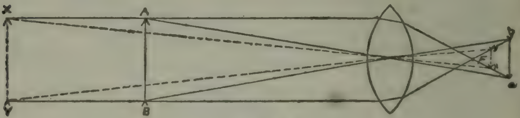


Fig. 3

the image is formed by the lens. It will be noticed that parallel rays of light are bent so as to go through F (the principal focus) and that rays passing through the center of the lens do not change in direction. This determines how far away the image will be from the lens. If the subject being photographed is 100 feet from the camera, the image will be formed a fraction of an inch closer to the lens than will be the image of an object only 10 feet away. This is shown by dotted lines in the diagram.

Focusing is the bringing of the lens to the proper distance from the film so that the image will be sharp, and as explained this is changed

according to how far away the object is which is being photographed. This distance from the optical center of the lens to the focal plane or position of the films when focused on a distant object is termed *focal length.* When choosing a camera and lens for ordinary usage it is well to select one having a lens of a focal length at least equal to the diagonal of the negative. A short focal length lens gives a small image. For this reason the worker is inclined to approach close to the subject in order to get a larger image. In such a case any portion of the subject such as a foot or hand of the person projecting a little toward the camera, will appear much too large in proportion to the remainder of the subject. This is often noticeable in amateur pictures. For instance, the focal length of a lens on a post card size camera should be from 6½ to 7 inches.

KINDS OF LENSES. The *meniscus lens* is the simplest type, being made from a single piece of glass. Such lenses are used only on small fixed focus cameras. When a beam of light is passed through a prism it will be noticed that a band of color is formed. This is because the longer wave lengths such as the red colors are bent less than the shorter ones such as the violet. A meniscus lens will not focus the various colors in the same plane and therefore is used only on the very cheapest cameras.

A *meniscus achromatic* lens is more fully corrected, being made from two kinds of glass, flint and crown, and overcomes the difficulty just mentioned. Such lenses are used on most of the box cameras and the less expensive folding models. These lenses are made to be

used only with rather small openings and so the user is limited to making a snapshot exposure in good bright sunlight. A lens such as this is very fine for landscape work or portraiture but if the subject is a building or other object containing straight lines, the lines will appear slightly curved if they come near the edge of the picture. If the stop opening is in front of the lens the lines will curve outward, but if behind it then they will curve inward.

Double lenses overcome this defect by combining two single lenses, one in front and one in back of the stop, so as to get straight lines to photograph as such, clear to the very edge of the picture. These lenses can be used at much larger stop openings in proportion to focal length than the meniscus achromatic or single lenses, and hence the name for the old type of double lens—"rapid rectilinear." These older double lenses still have one defect known as astigmatism or the inability to photograph both vertical and horizontal lines sharply to the very edge of the picture.

About 30 years ago, Professor Abbe and Otto Schott working together at Jena, found how to produce new kinds of optical glass from which lenses could be made that would give flat field images with the blue and yellow rays at the same focus. By the use of these new glasses the opticians have been able to make lenses that give sharp images and a flat field to the very edge of the picture. These lenses are called *anastigmat.* Better defining power, however, can only be obtained by the most careful and skilled work when making the lens, this work being of a far higher quality than that applied on the older types of

lenses, which accounts for the higher cost of anastigmats. They can be used with larger stop openings and thus it is possible to make snapshots on days when the sun is not shining and also to get slow snapshot exposures near a window if the light is good.

The "*Kodar*" lens is a recent development intermediate in type between the old "rapid rectilinear" and the anastigmat. It has many of the practical advantages of the latter though it is an inexpensive type of lens.

There are several types of lenses which are used for special purposes. Two of the most common are wide angle lenses and telephoto lenses. *Wide angle lenses* have a very short focal length for the size of the film or plate covered and are especially useful for photographing in confined positions, such as in a room where it is desired to include the greater portion of it. They are also rather necessary when trying to photograph buildings on the opposite side of a rather narrow street. The perspective is rather poor when working up close, as nearby objects appear too large in proportion to those more distant. The room looks much larger than it really is. Wide angle lenses must always be used with a smaller stop opening than those of ordinary focal length. For example, the Bausch & Lomb Medium Wide Angle Protar Lens Series IV has a maximum speed of f.12.5. The extreme wide angle Protar lens made by the same firm has its largest stop opening at f.18. The Goerz Hypergon lens has only a maximum opening of f.22, but this lens embraces an extremely wide angle of 135 degrees. The lens on the average hand camera includes an angle of perhaps 42 to 49 degrees.

Telephoto lenses on the other hand are most

useful for photographing objects that are so far away as to appear too small with a normal lens. Not only are they useful for photographing animals, birds, and other wild life but are useful for taking pictures of persons or buildings that are not usually accessible. As the light reflected from the subject must cover a larger proportion of sensitive film, it naturally follows that the exposure would be longer than when no telephoto lens was used. A steady tripod must be used as the least vibration will spoil the picture. A longer bellows draw is generally necessary although some of the new fixed magnification telephoto lenses do not require a long bellows extension for the equivalent focal length.

Soft focus lenses, an example of which is the Wollensak Verito F.4 lens, produce an image which is very pleasing for certain types of pictorial and portrait work.

STOPS AND SHUTTERS

When using a camera, it is very necessary to know something about *stops* or diaphragm openings.

A very instructive experiment for the beginner, if he has a camera with a ground glass focusing screen, is to set it up in front of some well illuminated object and focus it on the ground glass screen by moving the lens nearer or further from the ground glass. A coat or other dark cloth should be thrown over the head of the operator and back of the camera to exclude the light. When the shutter is set so as to remain open and the largest stop opening is used it will be noticed that there is a brilliant image of the subject on the ground glass but that it is upside down. If the picture being

examined is a landscape or other subject containing objects at different distances, it will also be noticed that those at a certain distance away will be sharply defined whereas others nearer and further away are somewhat diffused or blurred. In other words, they are out of focus.

If the size of the stop opening in front of the lens is decreased, it will be noticed that the image of objects nearer and farther than the one focused on becomes sharper, and that the image is not as bright as before. Thus we see that the two principal functions of the stop are to increase or decrease the depth of focus and to regulate the amount of light admitted to the sensitive film. This last function makes it an important factor in exposure. In the case of portraits it is usually better to have only the subject sharp for if the background were also sharp it would detract from the interest of the subject. For landscapes it is more necessary to have the entire picture sharp.

The amount of light reaching a given portion of the sensitive film depends not only on the size of the stop opening but on the distance of the lens from the film. With longer focal length lenses the distance is greater and therefore the light spreads over a larger area. Thus it is less concentrated, and so the exposure needs to be longer with the same actual size stop opening. The diaphragm or stop opening is always referred to in terms of its proportion to the focal length. In one system the stop is expressed simply as a fraction of the focal length. Thus, f.8 means that the diameter of the aperture or opening is 1/8 of the focal length. For example, if the lens opening or stop is 1/2 inch in diameter and the focal length is four inches, then the stop is f.8. Again, if the focal length is 8 inches and the

stop opening is one inch the ratio would be the same, and the stop would be marked f.8. In the latter case four times as much light would have been admitted, yet it would have had to cover four times as much space thus giving equivalent illumination to the film. The comparative exposure of two stops varies with the square of their f. values, the larger numbered one being the slower and requiring the longer exposure. In the U. S. (Universal System), the stops are so marked that each succeeding smaller one requires twice the exposure of the next larger.

The following table gives a comparison of the two systems:

F.	f.4	f.5.6	f.6.3	f.8	f.11	f.16	f.22	f.32	f.45
U.S.	1	2	(2½)	4	8	16	32	64	128

Most of the rapid rectilinear lenses have U. S. numbers. Anastigmat lenses usually have f. markings. The single lenses are more often marked with three or four numbers, 1, 2, 3 and 4, of which each succeeding larger numbered stop usually admits about half as much light as the next smaller and therefore requires approximately twice the exposure.

The *shutter* is a mechanical device for controlling the length of the exposure. One of the simplest forms is shown in the following diagram:

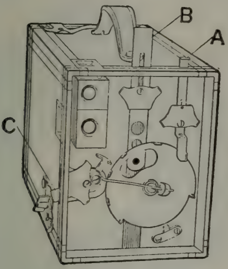


Fig. 4

Fig. 4 shows the position of slide B when the smallest stop is in front of the lens.

This form is known as a rotary shutter and may give snapshot exposures of approximately 1/25 of a second. An instantaneous exposure is made by pushing lever "C" across in one direction only. Ordinarily the largest of the three stop openings (controlled by slide "B") is used for snapshots in good light, the middle one for snapshot exposures of very distant objects and for time exposures of interiors. The small one is more often used for time exposures outdoors. To make a time exposure slide "A" is pulled up and then when lever "C" is pushed across in one direction the shutter will open and remain open until lever "C" is pushed across in the opposite direction. Figure 5 illustrates one of the more comprehensive types of shutters. The

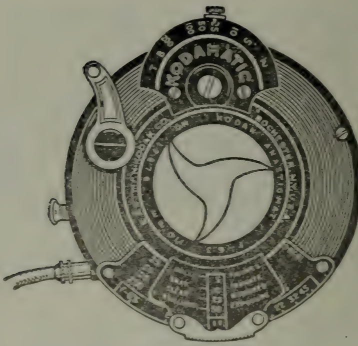


Fig. 5

size of the stop opening is controlled by moving "B" to the proper f. value.

FILMS AND PLATES

Photography begins with the chemical action of light on compounds of silver, particularly those of chlorine and bromine. This action is familiar to anyone who has added a solution of silver nitrate to a sodium chloride solution and watched the resulting precipitate of silver chloride darken after a short exposure to sunlight. Briefly, films consist of a base or support of either glass or transparent cellulose on which is coated an emulsion which holds in suspension some sensitive silver salts. Silver bromide is the principal sensitive material in

films and plates. This, together with the gelatin which is added to keep it from settling, makes up the emulsion. The different degrees of sensitiveness are obtained by varying the amount and duration of heat to which the emulsions are subjected during manufacture. Other substances may be added which also affect its sensitiveness.

The silver bromide or other compound in the emulsion is so sensitive to light that an exposure in the camera for but a very small fraction of a second under good lighting conditions, is sufficient to produce a developable image. The emulsion is composed of innumerable grains, perhaps from 10 to 30 billion per square inch, lying several deep. The number acted on during exposure depends on the intensity of the light and the duration of its access to the film. The light action is not visible after exposure but every grain that was at all affected during exposure can be developed. This is explained later in Chapters III and IV. It naturally follows that if the sensitive film is exposed to light at any time other than when the picture is being made, for even the smallest fraction of a second before being developed, it will be completely fogged as all of the grains of silver bromide will be affected and when developed will be completely dark.

In addition to speed another characteristic of modern films and plates is *latitude*. This means that the exposure can be varied considerably without appreciably affecting the final picture. Thus, if the least correct exposure was 1/100 sec. this could perhaps be increased to 1/25, or four times as much, without affecting the final result except that the negative would be denser and require a longer time in printing.

Films or plates with very slow emulsions are

more often used for copying and other work where it is desired to have considerable contrast and where speed is no object. The most rapid emulsions are necessary where extremely short exposures under ideal lighting conditions must be given, as for athletic events, and for slow snapshot exposures in poor light.

Ordinary plates and films are sensitive to the shorter wave lengths of light such as the ultra-violet, the violet and the blue, but little if any to the yellow and red. For this reason a blue flower or similar subjects will photograph so as to appear almost white, whereas a yellow or red one will appear nearly dark as the light reflected will not affect the film to any extent.

To counteract this some plates and most films are made somewhat *color sensitive* or orthochromatic by the incorporation in the emulsion of certain dyes which makes it less sensitive to blue light and more to the yellow-green rays.

For the exact rendering of reds and other colors, plates and films are sometimes still more fully corrected and these are termed panchromatic. While they are sensitive to all colors, yet they are somewhat more sensitive to the blues than the reds, and therefore a filter is often used.

The *filter*, which may be a piece of colored gelatin between two pieces of glass, is placed over the lens when photographing certain colored objects, and its function is to absorb or hold back the blue rays or certain other ones as desired. This will give time for the yellows and reds to affect the film and thus a denser deposit of silver will be obtained which will result in that part of the print being lighter. As the filter holds back some of the most actinic light, it is evident that the exposure will

have to be longer than when no filter is used. The length of the exposure will depend upon the type of sensitive emulsion being used and the kind of filter. A variety of filters can be obtained which will absorb different colors and thus it is possible to have any given color photograph lighter or darker if desired. For full correction so that all colors will photograph to appear relatively as dark as they should, it has been found that Eastman Commercial Panchromatic Film and a Wratten K-3 filter will produce the desired result.[3]

PRINTING PAPERS

Printing papers are sensitive in the same way as films or plates except that the emulsion is slower, and is coated on a paper base instead of glass or cellulose. The more rapid enlarging papers have a slow bromide emulsion while ordinary contact developing printing papers are usually silver chloride. The various contrasts and surfaces will be discussed in the chapter on printing.

[3]Discussed more fully in *Color Films, Plates and Filters.* Eastman Kodak Company.

CHAPTER III

MAKING THE PICTURE

Loading the Camera

Most hand cameras are made to take *roll film*. This is especially convenient as a dark-room is not required for loading. Extending the full length of the strip of film and several inches beyond each end is a strip of lightproof paper, which in connection with the flanges on the spool, forms a lightproof cartridge.

The loading operation is performed entirely by daylight, but a position should be selected where the light is somewhat subdued. Care must be taken before beginning the work to see that the shutter is closed. The empty spool is inserted in the winding end and the full spool is placed in the recess at the opposite end by pulling out the spool pins and allowing the film cartridge to drop into place, care being taken that the top of the spool is at the top of the camera. Otherwise the opaque red paper would be between the lens and the film. The spool pins are then pushed back into place in the holes at the end of the spool so that the spool revolves upon them. The gummed strip that holds the end of the red paper is next removed and the paper is sufficiently unrolled to thread into the empty spool. Unless it is kept taut it may slip and loosen sufficiently to admit light which would

fog the film. The back of the camera is next replaced and the winding key turned until the figure 1 appears at the little red window.

Film packs contain film similar to roll film but cut to the various sizes in use. They can be loaded and removed from the camera in daylight, the darkroom only being necessary when the films are to be removed from the pack and developed. The film pack consists of 12 flat cut films packed in a lightproof case and attached singly to strips of black paper the ends of which project from the top of the pack and terminate in tabs numbered from 1 to 12. By the use of a film pack adapter an ordinary plate camera is transformed into a daylight loading film camera. After the pack is placed in position in the camera, the tab marked "safety cover," is pulled out and torn off at the place marked. The first film is now ready for exposure. After making the first exposure, tab No. 1 is pulled out and torn off in the same manner and so on until No. 12 is removed which will draw the last film to the back of the pack. The films now being protected from light, the pack can be removed in daylight and another inserted.

Plates must be loaded into plate holders or into the plate magazine in the dark room illuminated only by a safelight lamp. *Cut films* are loaded similarly into film holders, film magazines, and also into film sheaths which are to be used in plate holders, by the aid of suitable safelight in the darkroom.

CHOICE OF SUBJECT AND VIEWPOINT

There are of course subjects innumerable which will make pleasing pictures. Regardless of whether the picture is a landscape or a portrait, there are several points that should be kept in mind in regard to artistic composition if the picture is to be pleasing pictorially as well as good technically.

COMPOSITION[4]. This may be defined as the bringing of things together in an orderly and symmetrical arrangement. It is not an exact science that can be depended upon to produce results mechanically, but its general principles can be applied in such a way as to aid materially in avoiding the inartistic.

The first lesson to be learned is to leave out what is not required. This is known as *selection*. By moving the camera to the right or left, up or down, focusing at different planes, and using different stop openings, much that is objectionable may be either eliminated or at least made unobtrusive.

Simplicity is the keynote of artistic work. Over-crowding must be avoided. Ordinarily the picture should have but one object or group of principal interest, all others being subordinate and helping support it.

There should be such a combining of masses, tones and lines as to produce a pleasing whole. This is known as *harmony* and *balance*. Objects should be so grouped that there will not be too

[4]See, Hammond: *Pictorial Composition in Photography.*

many shadows or highlights of equal importance. The exact center is the weakest portion of the picture and so important objects should be a little to one side and in some cases slightly above or below. The picture should balance, both vertically and horizontally, a large mass near the center being balanced by several smaller objects on the other side or by a smaller one further from the center.

In the case of landscapes, neither the horizon nor a vertical line should ever exactly divide the picture into two equal parts. If there are subjects of importance in the near foreground, the horizon line should be perhaps 1-3 down from the top as this gives a prominent foreground; for broad expansive views it should be the same distance from the bottom in order to direct attention to the sky and more distant parts of the landscape. A clouded sky should be included if possible. Clouds are a pictorial asset as they break up the monotony of the white sky and add greatly to the beauty and attractiveness of the picture, but they cannot ordinarily be obtained without the use of a filter. A sky filter is a little attachment which slips over the front of the lens, and as only the upper portion of the filter is colored it keeps back the excessive light from the sky without appreciably affecting the exposure. Thus many clouds will be brought out nicely in the picture which ordinarily do not show because of overexposure.

In landscape photography it is not generally advisable to introduce human figures as in nearly all cases they fail, either in costume

or in pose, to harmonize with the subject. The domestic animals, such as horses, cows and sheep, can, however, frequently be included with success. When human figures are introduced they should not look directly at the camera.

For pictorial landscape work a diffusion attachment as the Kodak Pictorial Diffusion Disk may be placed over the regular lens or a soft focus lens such as the Verito[5] may be used.

LIGHTING. This is of equal importance with the arrangement of the subject in the picture as it determines the strength and position of the lights and shadows. It is the variation in these that gives the picture depth and roundness, making the subject stand out from the surroundings. The beginner when making exposures in the sunlight should have the sun behind him, but a little to one side. If the illumination comes from directly back of the camera, the shadows are more or less lost, giving a flat appearance. However, contrary to the generally published advice, some of the most pleasing results may be obtained with the sun from in front but a little to one side. In such a case it is necessary to shade the lens from the direct rays of the sun. The exposure should be increased as there are more deep shadows.

STEPS IN TAKING THE PICTURE

After the folding camera is loaded, there are still the following steps to be carried out in taking the picture:

[5]Wollensak Optical Company, Rochester, N. Y.

1. See that an unexposed portion of film is in position for the exposure.
2. Open the camera, and set the focus if a focusing model is being used.
3. Adjust the diaphragm opening.
4. Set the shutter (on some types).
5. Hold the camera level and include the view wanted.
6. Make the exposure.

1. When roll film is being used, a fresh section should be turned into position immediately after each exposure. Similarly with film packs the tab should be pulled out as soon as each exposure is made so as to be all ready for the next. This is often overlooked by beginners with the result that two pictures are made on the same section of film.

2. On the bed of most adjustable hand cameras, is a *scale* marked with figures, usually 6 to 100, indicating feet. The front of the camera must be extended until the pointer is over the figure indicating the number of feet which the operator has estimated to be the distance to the subject. Some types of cameras are equipped with a screw focusing device—a revolving ring, which is marked with a scale and moves the lens back and forth. When using a large stop and working up close, it is necessary to estimate the distance carefully but when using a medium small stop such as f.16 and photographing an object 50 feet or farther away, the focus need be estimated only with approximate accuracy.

If the camera is 3¼x4¼ or smaller it may be used as if it were a fixed focus type by

extending the front to the 25 foot mark on the focusing scale and using stop f.11 (U.S.8).

3. In choosing the stop to use it is necessary to consider the amount of light available, the rapidity of movement of the subject, the depth of focus needed, and the shutter speed that is to be used. Large stops are necessarily used for slow snapshot exposures under poor lighting conditions, and for very rapid instantaneous exposures of moving objects in bright sunlight. They are also used to limit the depth of focus so as to make the principal object stand out from its background. This is more particularly desirable in portraiture. Smaller stops give sharper images especially over a greater depth of field, and are generally used for groups, views and other subjects, where the entire picture must be sharp. In such a case it may be necessary to use a tripod and give a time exposure.

While there are exceptions to the appended table of stops to be used, yet it will be helpful, especially to beginners.

f.4.5 (a) For extra rapid exposures when the light is very good, i. e., for moving objects at 1-100 to 1-1000 of a second.
(b) For portraiture indoors when the light is only fair and short time or bulb exposures are made.
(c) For slow snapshots outdoors when the light is poor, or indoors by a sunlit window.
This opening gives but little depth of focus so the camera must be carefully focused.

f.6.3 (a) For quick exposures of moving objects in good light with shutter speeds to about 1-300 second.
(b) For slower speeds on hazy and slightly cloudy days.
(c) For indoor home portraiture.

f.7.7 or f.8 (U.S.4) (a) For instantaneous exposures in slightly cloudy weather, speed 1-25. (Do not

attempt instantaneous exposures on dark, cloudy days.)
(b) For flashlight groups.
(c) For portraiture indoors or outdoors in the shade.

f.11 (U.S.8) (a) For all ordinary instantaneous exposures when the subject is in bright sunshine, using 1-25 sec.
(b) For flashlight interiors.

f.16 (U.S.16) (a) For instantaneous exposures when the sunlight on the subject is unusually strong and there are no heavy shadows, as for views on the seashore, or on the water, using speed 1-50.
(b) For ordinary landscapes in bright sunshine with clear sky overhead, speed 1-25.
(c) For interior time exposures.

f.22 (U.S.32) (a) For instantaneous exposures of extremely distant views.
(b) For marine or snow scenes, or clouds in bright sunshine, at speed 1-25.
(c) For time exposures of interiors, and of outdoor scenes in cloudy weather.

f.32, f.45 (U.S.64, U.S.128) (a) For time exposures outdoors in cloudy weather. Never used for snapshots.

4. When making instantaneous exposures it is necessary to see that the shutter is set at "I." In addition to this some shutters must be "set" by special levers, much as a gun is cocked, before they can be operated. If instantaneous exposures are to be made while holding the camera, a large enough stop must be used so that the exposure will be 1/25 second or less, as few people can hold a camera steady for a longer time.

5. When making the exposures, care must be taken to hold the camera level and have it include the exact view wanted. If the camera is inclined to one side, horizontal lines will be at an angle in the picture; if pointed up, a

building will photograph smaller at the top; if down, the opposite will be the case. If the camera is fitted with a rising front, it will be found useful for eliminating undesirable foreground or including the top of a tall building. In the case of architectural subjects it is especially important that the back of the camera remains vertical in order to prevent any distortion of the lines of the building.

A single reversible view finder is provided with most cameras. It is notched to indicate the view that will be included both when the camera is used vertically and horizontally. One should always look at the finder from directly above and not at an angle, or the view included will not be accurately seen.

6. Exposure is made by means of a lever, or cable release.

MAKING THE EXPOSURE

Exposure depends on such a variety of factors that only with practice will the worker be able to give consistently the correct amount under varied conditions. Nearly all of the subjects ordinarily photographed by daylight may be classified into four groups. Since the normal exposure for each of these groups may be easily memorized, the outdoor exposure problem is reduced to the simple one of determining to which group the subject belongs. While the table is eminently satisfactory for stationary objects, it is not adapted for rapidly moving objects as the shutter speed would be too slow. When using these tables, a faster or slower shutter speed may be used if the stop opening is varied accordingly so as to give the same amount of light. As explained, each succeeding smaller stop than f.8 (U. S.

4) admits about half as much light as the next larger. The exposure tables are for from 2½ hours after sunrise until 2½ hours before sunset on days when the sun is shining on the subject.

OUTDOOR EXPOSURE TABLES (Rectinlinear and Anastigmat Lenses)

Groups	Shutter Speed	Rectilinear Lenses Stop	Anastigmat Lenses Stop
1—Snow, marine and beach scenes, extremely distant landscapes	1/25	U.S. 32	f.22
2—Ordinary landscapes showing sky, with a principal object in the foreground	1/25	U.S. 16	f.16
3—Nearby landscapes showing little or no sky, groups, street scenes	1/25	U.S. 8	f.11
4—Portraits in the open shade, not under trees or the roof of a porch; shaded nearby scenes	1/25	U.S. 4	f.7.7 or f.8

OUTDOOR EXPOSURE TABLE (Single Lenses)

Groups	Folding Cameras Shutter Speed	Stop	Box Cameras
1	1/25	3	Snapshot with middle stop
2	1/25	2	Snapshot with largest stop
3	1/25	1	Snapshot with largest stop
4	1 second	4	1 second with smallest stop

Moving Objects. The briefest possible exposure must be given to moving objects in order that the motion may be stopped. Consequently such pictures can be taken only in bright sunlight and in most cases the largest stop opening must be used. Best results are usually obtained by taking the picture from

somewhat in front of the subject and a little to one side or perhaps at about a 45 degree angle. In this way the actual movement of the subject in relation to the camera is not so apparent as at right angles, and the perspective will be more pleasing. It is necessary to work back at some little distance if the subject is moving rapidly. If the shutter speed is 1/100 it will be necessary to get back perhaps 75 or 100 feet. On the other hand if a focal plane shutter is being used in connection with an f.4.5 lens, then an exposure of from 1/500 to 1/1000 will enable the worker to get somewhat closer and get sharp images of automobile races or similar subjects.

INTERIORS. Stop 16 or smaller should ordinarily be used for interiors in order to get nearby objects and those at the furthest side of the room sharp at the same time. Do not include any objects in the picture that are very close to the camera. The exposure for interiors varies widely according to different conditions but the following table for use with stop 16 (next to largest stop on single lens cameras) may be found useful as a guide:

White walls and more than one window—Bright sun outside, 4 seconds; cloudy bright, 20 seconds; hazy sun, 10 seconds; cloudy dull, 40 seconds.

White walls and only one window—Bright sun outside, 6 seconds; cloudy bright, 30 seconds; hazy sun, 15 seconds; cloudy dull, 60 seconds.

Medium colored walls and hangings and more than one window—Bright sun outside, 8 seconds; cloudy bright, 40 seconds; hazy sun, 20 seconds; cloudy dull, 80 seconds.

Medium colored walls and hangings with only one window—Bright sun outside, 12 seconds; cloudy bright, 60 seconds; hazy sun, 30 seconds; cloudy dull, 120 seconds.

Dark colored walls and hangings and more than one window—Bright sun outside, 20 seconds; cloudy bright, 20 seconds; hazy sun, 40 seconds; cloudy dull, 2 minutes, 40 seconds.

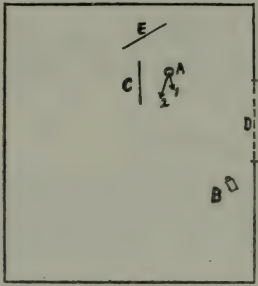
Dark colored walls and hangings and only one window—Bright sun outside, 40 seconds; cloudy bright, 2 minutes, 40 seconds; hazy sun, 80 seconds; cloudy dull, 5 miiutes, 20 seconds.

HOME PORTRAITURE

Excellent home portraits can often be made—pictures that will reveal the personality of the subject—in the unconventional surroundings of the home. In order to have the exposure time cut down to a minimum so that the subject will not move or have a set expression, a large stop opening should be used and the subject be placed close to a window. The most pleasing results are usually obtained when the light falls at about a 45 degree angle.

Too much posing is ruinous, especially in the case of children. They appear at their best when unconscious of the presence of the camera. It is very important that neither the hands nor feet or other portions of the subject project out too much toward the camera or they will appear too large in proportion to the remainder of the body. This is particularly true when using a short focus lens and working up close to get a large image.

By following out the diagram, (Figure 6), a good plain lighting is obtained:

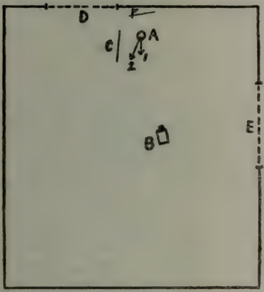


A	Subject
A-1	Direction of Face
A-2	Direction of Body
B	Camera
C	Reflector
D	Window
E	Background (if used)

Fig. 6

It will be noticed that the subject is placed even with the edge of the window or a little back of it and about as far into the room as the window is wide. The body is turned somewhat away from the light and then the face turned back into it until a v-shaped patch of light is noticed on the cheek. This will give roundness to the features. A sheet or newspaper may be used to reflect light onto the shadow side of the subject. Enough reflected light must be used to show detail, but if too much is used the face will appear flat.

A more difficult lighting is the one shown in Figure 7.



A	Subject
A-1	Direction of Face
A-2	Direction of Body
C	Reflector
D	Window
E	Window (for general illumination)
F	Background (if used)

Fig. 7

A back lighting of this type is much used in showing movie effects. Because of taking the picture toward a window it is much more difficult than the plain lighting. It may be necessary to use a lens hood to keep the excess light from the window from striking the lens, producing a fogged appearance.

Flashlight if properly controlled is one of the best sources of illumination for home use. The light is available on dark days and evenings, and as the flash occupies but a fraction of a second, there is not much danger of movement. The lighting should be arranged the same as shown in Figure 6, the flash taking the place of the window.

CHAPTER IV

DEVELOPING THE NEGATIVE

After exposure, the film or plate shows no visible change but the "latent image" is there and by the aid of suitable chemicals and solutions it can be brought out and made visible or in other words be "developed." Such solutions are termed developers.

CHEMICAL PROCESS. This consists in the removal of the bromine or chlorine from the silver bromide or silver chloride of the emulsion where the light has acted, so as to leave the grains of metallic silver which constitute the photographic image.

Of the *developing agents* which are capable of bringing out the image, pyro, hydroquinone and Elon are perhaps the most commonly used for negatives, although Elon is seldom used except in connection with one or the other.

Although one of the oldest developers, pyro has long been considered one of the best for the development of films and plates. It surpasses other developers in the control it gives over the printing quality of negatives as the color can easily be varied from a blue-black to a slightly olive or yellowish tone. A slight stain image in addition to the silver image is desirable as thus the negatives will not need to be so dense as though they were blue-black. The present tendency is to use pyro either in connection with Elon or with Elon and hydroquinone. Beginners are likely to get the negatives a too decided yellow; also pyro if somewhat oxidized will stain the finger nails. An

Elon-Hydroquinone combination is one of the most popular developers, and being non-staining it is especially good for tray development.

A solution of pyro, Elon, or hydroquinone and water, will develop so slowly that an *alkali* such as sodium carbonate is added to speed up the action. In the presence of an alkali, however, the developing agent quickly oxidizes, making the solution somewhat colored. To prevent this oxidation, a *preservative* such as sodium sulphite is added which keeps the developer clear without otherwise affecting its properties. In order to minimize the tendency to fog (the development of the unexposed grains of silver salts), a trace of potassium bromide, a *restrainer*, is usually added.

TANK DEVELOPMENT

Within recent years the tank method has come to be preferred by the majority of workers. If *roll film* is being used, a special tank developing machine consisting of a wooden box, a lightproof apron, transferring reel, and metal solution cup will be necessary (Fig. 8). No dark room is required. The film is wound

Fig. 8

into the apron according to instructions and transferred to the solution cup where it is left in the developer for a predetermined time. This is a logical scientific method, development being continued for a definite time in a solution of a given strength at a known temperature. It will produce a technically correct negative and in the hands of the average person will no doubt give the highest percentage of good results. If the exposure is at all within the latitude of the film, the negatives will be of proper contrast, differing in density according to the exposure and although requiring different printing times will give prints of similar quality.

Film packs may also be developed in special tanks but a dark room is necessary when loading them into the tank.

Cut films and *plates* are usually developed in open tanks and this operation must be carried on in the dark room. The work may be done either by the time and temperature system or the inspection method.

TRAY DEVELOPMENT

Tray development is not usually considered as convenient a method as tank development but it has its advantages and is used by many workers. Not only does it give an insight into the actual process, but it affords an opportunity for the pictorial worker to secure results other than an exact representation of the subject. Tray development must be carried on in a dark room which is entirely free from white light and which is illuminated only by a light such as given by a Brownie Safelight Lamp when fitted with a Series 2 Safelight.[6]

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[6]Described in *Modern Dark-Room Illumination,* Eastman Kodak Co.

Four trays are necessary, one for clear water, one for the developer, one for a rinse bath, and one for the fixing bath.

Many workers prefer to purchase their chemicals made up in small packages and ready for use with only the addition of water. This is a very convenient method. Others are interested more in the science of photography, and prefer to make up their own solutions from formulas. Of the many good formulas available but one will be given here[7]:

Elon-Hydroquinone Tray Developer

Water (about 125° F.)	8	ounces
Elon	22	grains
Sodium sulphite	1½	ounces
Sodium bisulphite	15	grains
Hydroquinone	42	grains
Sodium carbonate	82	grains
Potassium bromide	12	grains
Water to make	16	ounces

For use dilute with equal parts of water. The temperature should be 65 degrees Fahrenheit.

Development. If roll film is being used it is first detached from the red paper on the roll, and then, one end being held in each hand, it is passed face down through a tray of clear water several times to eliminate air bubbles and to prevent curling. Next it is passed back and forth through the developer in the same manner, this motion being continued until development is complete.

Ordinarily the films should remain in the developer until the picture is about faded out

[7]Those who are interested in preparing other types of formulas should have a copy of *Elementary Photographic Chemistry* which can be obtained free from the Eastman Kodak Co., Rochester, N. Y.

on the side where it first appeared and begins to show quite well on the back. Longer development will not only make the negative denser but will result in more contrast or a greater difference in density between the highlights and shadows. Therefore development should be continued until the negative is of the proper density and contrast to give good prints on the type of printing paper which is being used. Naturally it will take some experience to know just when the correct point is reached. The negatives may be examined by holding them up in front of the safelight lamp but they should not be held there for more than a few seconds at a time.

Because of the extra transparent coating on film packs, the purpose of which is to lessen the possibility of scratching the emulsion on drawing the tabs, about 1-3 longer development is required than for roll film. Super-speed film also requires longer development. Panchromatic film, being sensitive to all colors, must be developed in total darkness or by the aid of a deep green light.

Rinsing. When developed, films are rinsed for a few seconds in clear water and then transferred to the fixing bath. The following rinse bath may be used instead of clear water and has the advantage that it will not only harden the films but will stop development at once.

Water	16 ounces
Potassium chrome alum	½ ounce

The negatives should be left in this bath for two or three minutes, being moved about especially when first being immersed. The hardening bath should be renewed frequently.

Fixing. After the negatives are developed the particles of silver bromide which were not

affected by the light are still sensitive and so must be removed by a process called "fixation." Here the hypo (sodium thiosulphate) combines with the unexposed grains of silver bromide or other silver salts to form a compound which is soluble in water and therefore which can be removed by washing.

Either a chrome alum fixing bath or an acetic acid fixing bath may be used, but the latter will be given here as this formula is suitable for prints as well as negatives.

Acetic Acid Fixing Bath

A

Hypo	16 ounces
Water to make	64 ounces

When thoroughly dissolved, add the following hardening solution:

Water (about 125° F.)	5 ounces
Sodium sulphite	1 ounce
Acetic acid (28%)	3 ounces
Potassium alum	1 ounce

The chemicals should be dissolved in the order given using water at about 125° F. Be sure that the sodium sulphite has completely dissolved before adding the acetic acid. After the sulphite-acid solution has been thoroughly mixed, add the potassium alum and stir until completely dissolved. Add the cold hardener solution (B) slowly to the cold hypo solution (A), stirring the latter continually.

The negatives when first being placed in the fixing bath should be moved about for a few seconds and then occasionally during the entire time of fixation. This should be for about 15 minutes or for twice as long as it takes to clear them of the white milky appearance. If not kept separated properly or if removed too soon the negatives will later discolor, probably show-

ing yellow stain. Sixty-four ounces of this bath will completely fix the equivalent of 200 $3\frac{1}{4}$x$5\frac{1}{2}$ negatives if the Alum Rinse Bath is used.

Washing. When removed from the fixing bath, negatives contain in the gelatin a number of chemicals which must be removed if permanency is to be assured. These include the hypo and other chemicals of the fixing and hardening bath and also other compounds formed by the reaction between the hypo and silver salts, and also possibly some carried over from the developer. Washing should be for 30 minutes in running water or for five minutes each in six changes of water.

Drying. Superfluous water together with any grains of dirt from the wash water should be removed from the film or plate by swabbing gently with absorbent cotton which has been saturated with water. Roll film may be hung up to dry in such a way that neither side touches anything. Drying should take place where there is circulation of warm, dry air, but not in the sunlight or where the temperature is too high or the emulsion may melt. Neither should the negatives be dried in a dusty location as any specks of dust will show up as white spots when the negatives are printed.

NEGATIVE DEFECTS

After the process of development is complete and the negatives are dry, it may be found that some of them have been underexposed or overexposed or underdeveloped or overdeveloped. The following table indicates the results that should be expected from variations in exposure and development.

Exposure	Development	Result
Under	Under	Very thin and weak, only highlights visible.
Under	Normal	Thin, shadow detail weak or lacking.
Under	Over	Thin shadows, dense highlights, very contrasty, often fog.
Normal	Under	Thin, flat, detail throughout but weak.
Normal	Normal	Correct density and contrast, good detail in all parts.
Normal	Over	Rather dense with too much contrast; detail may be obscured in in highlights.
Over	Under	Somewhat thin, very flat, full detail.
Over	Normal	Rather dense, somewhat flat, plenty of detail in all parts.
Over	Over	Very black or nearly opaque, shadows too heavy, detail lost in the high lights.

Sometimes negatives are defective in some way and need treatment before being printed. Those that are too thin and flat, having a short scale of contrast as the result of underdevelopment, should be *intensified*. On the other hand if the negatives have been overexposed or overdeveloped they should be *reduced*. Formulas for these processes are given in *Elementary Photographic Chemistry*.

CHAPTER V

PRINTING THE PICTURE

Printing is perhaps the most interesting of all the phases of photographic work. While correct lighting, exposure, and negative making cannot be too strongly emphasized, it is after all the finished print that has been the end in view through each successive step.

PRINTING PAPERS

PRINTING-OUT PAPERS. The earliest printing paper, plain silver paper, was introduced by Fox Talbot about 1840. This was followed by albumen papers, examples being found in the family albums of a generation ago. Later came the silver chloride papers of the collodion and gelatin types. In addition to these printing-out papers are others such as platinum, and carbon, both of which are used quite largely by pictorial workers. Blue-prints, which are now mainly used for architect's drawings, are made by one of the simplest of processes. After exposure to sunlight through the negative until the image is visible except in the highlights, washing in water completes the process, as development and fixing are not required.

DEVELOPING PAPERS. These are used almost exclusively at the present time. They are very similar to films except in regard to the kind of support and in the speed. Papers for contact printing usually have silver chloride for the sensitive silver salt. These are not as fast papers as those used for enlarging, which more often have silver bromide for the sensitive compound.

SELECTION OF PAPER. The multiplicity of papers available presents a valuable means of producing not only distinctive work but also getting out that which is best technically and artistically from every negative. Photographic papers are made in both *single* and *double weight*, the former being well suited to small prints and those which are to be mounted flat; the latter being more desirable for post cards, for prints with borders that are to be left unmounted and for professional work that is to be placed in folders.

Emulsions are usually coated on a white or buff stock though occasionally on a cream or ivory base. Printing papers are made in many *surfaces*—glossy, semi-gloss, semi-matte, velvet, smooth-matte, slightly rough, rough lustre, rough matte and others. If something out of the ordinary is wanted there are papers with silk, linen and canvas surfaces as well as emulsions on tissue, parchment and canvas. The semi-matte, and velvet surfaces are preferred by many, although the brilliant glossy prints are best for reproduction. Matte papers are used for a large proportion of portraits.

Contrast. As the print is made by allowing light to shine through the negative on to a piece of sensitive paper with which it is placed in contact it follows that a very thin portion of the negative will result in dark shadows in the print. Similarly over-dense highlights of the negative will hold back so much of the light that the lightest parts of the print will be perfectly white. The professional photographer produces negatives of reasonable uniformity and therefore professional papers are usually made with only one degree of contrast. The amateur on the other hand works under such widely varying conditions that it is almost impossible to secure uniform negatives. So his printing papers are made in several degrees of contrast,

usually three or four, to take care of the different types of negatives. In the case of papers such as Velox or Azo, having contrasts numbered from one (the softest) to four (the most contrasty), the following table should be of help:

No. 1.—A very soft paper used when printing from contrasty negatives, or when soft effects are wanted.
No. 2.—A medium contrast paper used for average negatives. Portrait papers are of about this contrast.
No. 3.—A more contrasty paper desirable for weak, thin negatives.
No. 4.—A very contrasty paper for negatives that are thin and flat. Also used where much contrast is wanted as when making pictures of printed matter, line drawings, and maps.

A print to be technically perfect must correctly reproduce the variations in light and shade of the original subject in their proper relation and depth. In other words, a paper should be selected which is of such contrast that when printed, no portion of the picture will be absolutely white without detail and none will be completely black, obliterating detail. However, the scale of tones should be as long as possible without losing this detail.

PRINTING PROCESS

The necessary materials for making prints are few in number and simple in character. Developing and fixing solutions as well as a short stop bath, and water for washing and prints are of course essential and should be ready before starting. As the printing papers are sensitive to white light the work must be done in a very subdued light or in a dark room lighted by a safelight lamp fitted with a yellow safelight.

EXPOSURE. The negative is placed upon the glass of the printing frame or printing machine with the back or shiny side down. Over this is placed a piece of sensitive paper with the sensitized side in contact with the dull side of the negative and then the back of the frame is replaced or the top of the printing machine pushed down. With the frame the exposure is accomplished by holding it a few inches from an electric light bulb or other light source for a few seconds. The time of the exposure will have to be found by experiment. With amateur papers such as Velox, the time of exposure must be such that the print will develop up to the proper depth in about 45 seconds in the developer designed for it at a temperature of 70 degrees. Portrait papers usually require about 1½ minutes for full development and enlarging papers may require still longer, in certain cases. If it is found that upon development for the proper time that the print is too light, it is evident that the exposure has been insufficient and must be increased for the next print. On the other hand if the print develops up to the proper depth too quickly, the exposure has been too great and the print will be mottled and muddy. When making the exposures, there is of course a good opportunity for dodging or holding back certain parts of the picture. Also, there is endless opportunity for making vignettes, borders, combination prints and other types that are not especially difficult but which cannot be described in a book of this size. The reader is urged to consult some more comprehensive work.[8]

DEVELOPMENT. The function of the developer and the chemistry of development are the same as for negatives and need not be repeated. A

[8]See Snodgrass: *The Science and Practice of Photographic Printing.*

Metol (Elon)—hydroquinone combination (MQ) is now almost universally used. Sodium carbonate has the same function as in the negative developer but the sodium sulphite here largely acts as a preservative. Potassium bromide is the chemical in the print developer that controls the color. Enough bromide must be used to prevent fog or development of the unexposed grains of silver salts, and this gives a print of a blue-black color which if sepia-toned will tend to be purple. A larger quantity under similar conditions of development gives an olive toned black and white print which is likely to tone to a yellow sepia.

The *formula* recommended by the manufacturer should always be used. A specimen formula (Velox) is given:

Water (about 125° F.)	8 ounces
Elon	22 grains
Sodium sulphite (powdered)	¾ ounce
Hydroquinone	87 grains
Sodium carbonate (powdered)	1 ounce 55 grains
Potassium bromide	13 grains
Water to make	16 ounces

For use, take Stock Solution 1 part, water 1 part. Develop 45 seconds at 70° F.

If placed in bottles filled to the neck and tightly corked it will keep for several weeks.

Method of Development. Four trays containing respectively developer, short stop bath, fixing bath, and water, arranged in that order should be ready before starting to print. The same type of fixing bath as recommended for negatives should be used. The short stop bath consists of water 16 ounces and acetic acid (28%) ¾ ounce.

After the exposure is made, the tray containing the *developer* is tipped to one side and the

print slid in face up from the high side of the tray which is immediately tipped the other way causing the solution to quickly cover the entire print. The print should be left in the tray which is rocked slowly to secure evenness of development until within about 5 seconds or so of the completion of the process. Then while the print is held up to drain it can easily be seen when the proper depth is reached. It should immediately be transferred to the short stop bath.

Development should be carried on for the length of time indicated as correct by the manufacturer of the printing paper and at the temperature recommended. After some experience it is perhaps better to learn to develop by inspection. Correctly exposed prints are properly developed to the correct depth when all the light affected particles have been reduced or when the light action seems to stop. If the print becomes too dark before it seems to pause in development, then it has been overexposed. If it must remain in the developer for some time in an attempt to force up the image, the print will become discolored.

The print when placed in the *short stop bath* should be moved about for two or three seconds and should then be transferred to the fixing bath, or it may remain until a few more prints are made. A short stop bath will stop development immediately and will also prevent the alkali and carbonate from being carried over into the fixing bath. *After the fingers have been in the short stop bath or fixing bath, they must be washed and dried before being placed back in the developer.*

Fixation. The prints should be fixed in 15 minutes. A long immersion may cause bleaching, or discoloration if the bath is too warm. The prints must be turned over and separated

a number of times during the process of fixation to be sure that all the silver salts are eliminated. If they are not thoroughly fixed they may turn pink and gradually fade. If the rinse bath has been used, 64 ounces of the fixing bath should properly fix 200 $3\frac{1}{4}$x$5\frac{1}{2}$ prints. Should the fixing bath become milky in appearance it should be discarded at once.

WASHING. Washing prints by hand is perhaps the most certain method of eliminating chemicals from the paper and emulsion. Prints are placed in a tray of clear water and after four or five minutes are transferred one at a time to another tray of clear water of similar temperature; the first tray is again filled with clear water and the process is repeated until the prints have been passed through 10 or 12 changes of water. If the change in temperature from one wash water to another or from the developer to fixing bath or from the fixing bath to the wash water, is very considerable, blisters are likely to result. If running water is available and the prints are kept separated, they should properly wash in about one hour.

DRYING. Prints except those having a glossy surface should be dried face down on photo lintless blotters or on cheese cloth stretchers. Glossy prints are rolled into contact on ferrotype tins and when dry have a very smooth shiny surface. Drying machines are used in commercial photo finishing establishments where it is necessary to turn out hundreds or even thousands of prints a day.

After the prints are dry they are likely to have a decided curl inward. They can be straightened by drawing them sharply over the back of a table, although there is danger of cracking the emulsion. A better way is to dampen the backs slightly with a wet sponge or cotton and then place them between heavy

lintless cardboards under a few pounds pressure until dry again.

ENLARGING

Enlargements are in no way materially different from ordinary prints except that a faster paper is used and the image is formed by projection through a lens as when being made in the camera, instead of by contact. With the advent of the modern fast enlarging papers of contact quality, this method of printing has become so simplified that beautiful enlargements of any reasonable size can easily and quickly be made from small negatives of good quality. Thus the ambitious worker with his ever present Vest Pocket Kodak fitted with an anastigmat lens is always ready for any emergency, knowing that whenever a worthy negative is secured it may be used to produce a large picture the equal of a contact print from a larger camera.

For a long time fixed focus enlarging machines or focusing machines were used. However, the Automatic Focusing machines are so much more convenient that they are coming into general use. Being automatic in focus much time is saved over the kind where it is necessary to attend to getting the proper sized image and the correct focus at the same time. Some of these cameras have supplementary lenses which may be used over the regular lens when softness and diffusion are wanted. The process of development, fixing, washing and drying is similar to that of making contact prints.

TONING[9]

For most photographic subjects nothing is

[9]For more exhaustive information on toning see Snodgrass: *The Science and Practice of Photographic Printing.*

Elementary Photographic Chemistry. Eastman Kodak Company.

more satisfactory than a good black and white print. Occasionally, however, such a subject as an autumn landscape is more truthfully rendered in a warmer tone while pictures of people are often preferred in sepia tones as being more true to life. Of the two principal methods of producing sepia tones, the redevelopment and the hypo-alum, the former is usually preferred for amateur work as it is more simple.

FINISHING THE PICTURE[10]

Keeping prints loose in a box or drawer is a most unsatisfactory method of preservation, as they soon become dirty or lost. Mounting them in folders or on card mounts is better but for average amateur work this is not so good as keeping them in albums.

When selecting mounts, it is well to remember that a light mount will make a picture appear darker and consequently should be used for a print that is too light. Similarly a dark print should be placed in a still darker mount. Black and white prints generally look best on gray mounts and sepia on brown ones.

Nearly all prints are improved by judicious *trimming*. Anything that does not help center the interest should be eliminated. Vertical and horizontal lines that are not true should be corrected whenever possible. A good, clean cut edge along with square corners can be secured by the use of a regular trimming board.

If prints are to be *dry mounted*, they should not be trimmed until after the mounting tissue is attached to the print. Dry mounting has the decided advantage that prints can be mounted perfectly flat on thin mounts or album leaves. It is very easily done and does not get the print or mount soiled and the print is protected from

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[10]See Photo-Miniature No. 188: *The Exhibition Print.*

possible moisture and injurious chemicals in the mount. A piece of dry mounting tissue is attached to the back of the print by touching it in a couple of places with a hot iron. The print is now turned face up and with the adhering tissue is trimmed to the proper size. Next it is placed in position on the mount, covered with a thin card and put under pressure for a few second in a dry mounting press, or a flat iron may be used.

After the print is mounted it is often necessary to do some *spotting*. Any small white spots are filled up, using a No. 1 sable brush and a card of spotting colors.

Many prints are made more effective by *handcoloring*. Tinting with water colors is perhaps the most popular method, although studio work is often done with oil or pastel colors.

CHAPTER VI

MOTION PICTURES

From an economic standpoint the motion picture business, including the manufacture of film and other materials, and the production and showing of pictures, is one of the major industries of the country.

In the past, entertainment has been the primary aim of motion pictures. Now the field is broadening until it seems likely that their greatest contribution to mankind will be in science, in industry, and in education. Especially in research work are they valuable as cameras have been devised that will take from 500 to 4000 pictures a second of such subjects as a bullet piercing armor plate, a bird in flight, mechanical motion, chemical action, or rapidly moving microscopic life. The pictures can then be printed individually or can be projected as slow motion pictures at only a fraction of the speed at which they were taken, so the subject will seem to barely move. By analyzing motion many extremely important facts have been learned. In industry such pictures may be used to show where lost motion can be eliminated and how an operation can be performed more efficiently. When it comes to athletic sports, it is very difficult for the individual in football, tennis or crew to realize just where his weakness lies, and what he lacks in form, but when he sees himself on the screen as he actually performs each individual movement, he can improve himself accordingly.

As it is generally recognized that knowledge is more quickly gained by the visual method than in any other way, schools, colleges and universities are using motion pictures more and more as an aid in teaching all kinds of subjects. Often there is no sharp line between educational and entertainment films. Dramatic films may be found useful for art classes; science and travel films in the study of such subjects as physical geography, geography and history. Films showing such interesting phases of nature study as micro-organisms, the life history of the bee, and the emerging of the butterfly are invaluable in teaching biology and its allied sciences. Even in the lower grades, animated drawings and maps and other types of pictures find their places.

PRINCIPLE OF MOTION PICTURES

Motion picture cameras are arranged to take long rolls of film, often several hundred feet in length. Standard film is 35 mm. (1⅜ inches) wide. By turning a crank at a uniform rate of two revolutions a second, the film is carried past the lens and eight exposures are made at each revolution, or 16 a second, which uses about one foot of film. A revolving shutter admits light to the film which stops during the exposure. Each picture is made in $\frac{1}{16}$ of a second and during this time the shutter must open and close and a new section of film be drawn down for the next exposure.

The film is developed, fixed, washed and dried and then printed on positive film which in turn must be developed, fixed, washed, dried and perhaps tinted.

The motion picture as seen on the screen is really a series of still pictures projected at the rate of 16 a second. Each picture is on the screen but a fraction of a second, the film not moving during this instant. Then the rotating shutter covers the lens in the same way as when the picture was being taken while a new view is brought down into position. During the time between pictures, the screen is perfectly dark, but because of "persistence of vision," this is unnoticed so that to the audience the projected still pictures make up the regular motion picture with which they are familiar.

PICTURES IN THE HOME

The desire for making personal motion pictures is a very common one. So irresistible is this appeal that almost everyone has long wished for movies of the people who particularly interest them, movies that they could make themselves and then show in their own homes. But until recently there have been outstanding obstacles. Ordinary film is so inflammable that many states have laws against its projection except in fireproof booths. This often makes it impossible to show pictures in a small school, church, or home. Also, standard film, which is taken at the rate of 1 foot a second and then has to be printed on an equal amount of positive film, makes the process expensive for those who wish to make their own moving pictures.

To overcome these disadvantages simple motion picture cameras such as the *Ciné-Kodak* (Figure 9) are now made which use only a narrow width safety film, 16 mm. (5/8 inch) wide. Some are operated by a crank the same

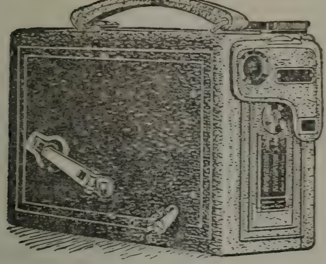

Fig. 9

as professional cameras; others by a spring motor. With the type using a motor, the camera can be held in the hands when the picture is being taken.

Four hundred feet of this film gives the same period of projection when used in the *Kodascope* (Figure 10) as a thousand feet of ordinary standard film, and as the film which is sent to the manufacturer for development, is reversed to a positive by chemical treatment, printing on a regular positive film is unnecessary. For this reason the expense is only about 1/6 that of making standard size motion pictures.

FILM LIBRARIES. Although movies made in and around the home are so completely fascinating in themselves, nevertheless, the Kodascope offers another feature for the home entertainer. Hundreds of thousands of feet of

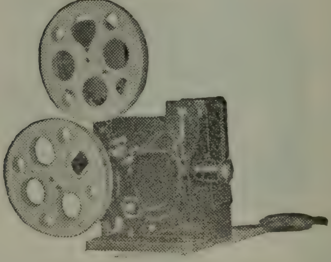

Fig. 10

professionally made pictures have been leased for use to the Kodascope Libraries, Inc.[11] Thus it is possible to rent films to fit any type of entertainment—comedies, dramas, animated cartoons, educational films—everything, in fact, most suitable for home projection,—and new films are being added continually.

[11]At 35 West 42nd Street, New York City.

CHAPTER VII

SCOPE OF PHOTOGRAPHY

The average person thinks of photography in connection with motion pictures, snapshots, and perhaps occasional photographs, but these are only a small part of the total contribution photography makes to the world.

The field of photography as an avocation comes very close home to all of us. No matter what may be our hobby, whether swimming, canoeing, fishing, hiking, or other kindred sports, photography is a natural ally. It is not only the interest that our friends manifest in our pictures that justify their making. It is the pleasure we experience in reviewing the picture record that makes photography so eminently worth while. As time passes and details fade from memory, the pictures of the outings so vividly recall the various scenes and incidents that we live those joyous days over again as often as we wish.

The ever increasing multiplicity of ways in which photography is used commercially makes possible only a bare mention of some of the more important. As a *business* it consists roughly of four types of work—portrait, commercial, amateur finishing and motion picture work. Through the application of photography there have been many definite advances in observational *scientific investigation.*[12] Photog-

[12]See *Photography as a Scientific Implement,* published by D. Van Nostrand Company.

raphy is made use of in law courts as evidence in the case of accidents and in deciphering charred records; in dentistry and medicine it enables the doctor through the X-ray to make a definite diagnosis and have records for analysis and study. In meteorological work a study of clouds, storms and floods is made by the aid of the camera, while the astronomer is able through the cumulative character of light action to show stars which are so faint because of their great distance that they are invisible even through the most powerful telescopes. In war times photography is the leading factor in securing much valuable information, airplanes equipped with special cameras being used to locate the enemy's position, detect camouflage, and make aerial maps from which firing data is worked out. In efficiency tests in the big industrial plants motion picture records are made of the operations both of machines and men to show where excess and loss can be eliminated so as to speed up production. The engineer and the contractor can also check up on the work of individuals as well as make actual records of details and show the progress made from day to day.

And then there is the widespread use of pictures in the magazines and papers both as *illustrations* and *advertisements*. There is scarcely an article on the market which is largely advertised that is not accompanied by a cut of some kind. In this connection it must be pointed out the close relationship of photography and photo-engraving. The engraver uses the photographic print to make the cut from which the magazine and newspaper pictures are printed.

Color Photography is another line in which

definite advances are being made. Pictures in monochrome while quite faithfully translating color values into shades of black and white and answering all ordinary requirements, yet are most unsatisfactory for depicting the grandeur of a mountain view or the sublime beauty of an evening sunset. Innumerable processes have been brought forward from time to time and many patents have been granted for photographic color processes. However, no method has yet been devised for making pictures in color that even remotely approaches the simplicity of ordinary black and white photography.

The autochrome process as introduced by M. M. Lumiere of Lyons, a screen plate process, is perhaps the simplest adaptation. It consists of a glass plate coated with a sticky varnish on which is dusted a mixture of fine starch grains which have been dyed the three primary colors and mixed together in suitable proportions resulting in a colorless coating. Over this is applied a coat of water proof varnish and then a very thin panchromatic emulsion. The exposure is made as in the case of an ordinary plate except that the glass side is toward the lens. By this means the exposure is made through the orange-red, green and blue-violet starch grains which act as filters. The exposed plate is developed for a definite time or by inspection, by the aid of a special green safelight. After rinsing it is immersed in a reducing solution which will dissolve out the finely divided silver forming the negative image. When this deposit has been removed the starch grains transmit light like those which came to them in the camera. The remainder of the silver salts not affected by the

primary exposure and development is now reduced to metallic silver. This development must take place while the plate is exposed to a strong white light. The plates when finished must be viewed either as transparencies or on the screen as lantern slides.

Color printing processes are hardly practical for the average amateur. Three negatives are made on panchromatic (color sensitive) plates or films using orange-red, green and blue-violet process filters. Each negative must be printed in its complementary color. The colors in which they are printed may be obtained from pigmented papers such as carbon; or colored inks, paints or other coloring materials may be used. The three carbon tissues or prints are then transferred to the same final support being cemented down in correct register. In spite of all the difficulties attendant on color photography, even motion pictures in colors are now possible.

There have been other advances which are almost unbelievable. Objects more than one hundred miles distant, practically invisible because of the atmospheric haze, have been photographed by suitable color sensitive films and filters. Pictures are made in the dark by means of the invisable ultra-violet ray while there are great possibilities with the infra-red rays and X-rays. With other constant developments in all phases of photographic work, who can prophesy what the future will bring forth?